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Network standby: moving forward with a new policy framework

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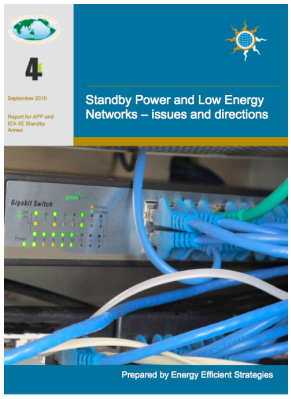
Overview

- Networks
- Networks and energy
- Policy approaches
- Functions
- The new framework

(to find report, google the title)



Context

- "Regular" standby occurs in every more products, but much progress in recent years
- Widely horizontal requirements in place
  - e.g. EU 1275/2008 – "Lot 6"
- Problem not solved, but is contained
- BUT, network connectivity in these modes not part of policy system, AND
  - More products with network interfaces
  - More time spent in networked low-power modes
  - Reduced 'regular' standby levels means more power "cost" for network connectivity
  - Perceived and actual complexity introduced by networks

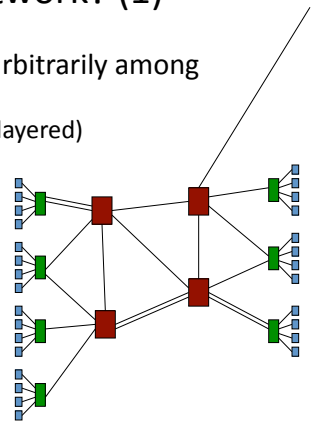
Solution

- Move from universal named modes to "functional approach"
  - Necessary for network standby
  - Helpful for all modes
- Affects test procedures and requirements
- Definitions of functions can be harmonized and requirements applied to categories of products
- Only way to be maximize effectiveness and minimize complexity

What is a Network? (1)

- Ability to communicate arbitrarily among many nodes
- Designed on OSI model (layered)
- Digital
- Usually IP (Internet Protocol)

- data links (1 to 1) also of interest; analog too

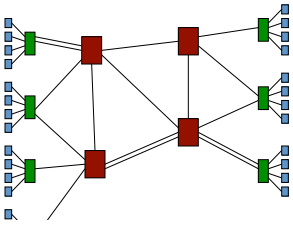


What is a Network? (2)

Layers of connectivity:

- **data link**
  - (PHY: Ethernet, Wi-Fi, …)
- network (IP)
- **application**

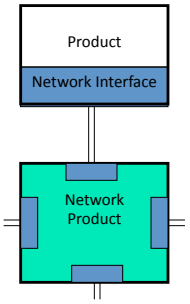
OSI Model Layers
1-physical
2-data link
3-network
4-transport
5,6,7-application



How networks drive energy use

- **Direct**
  - Network interfaces (NICs)
  - Network equipment
- **Induced** in Networked products
  - Increased **power levels**
  - Increased **time** in higher power modes (to maintain network presence)

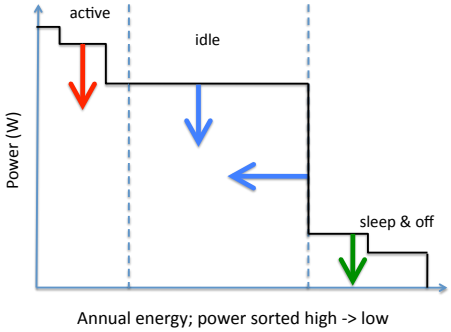
Network induced consumption **>** **all** direct



Network equipment ….
Routers, switches, modems, wireless APs, …
… vs **networked** equipment
PCs, printers, set-top boxes, …

Core methods to reduce energy use

- active power
- low-power mode power
- idle time or power



Network fundamentals

- The behavior on the network of one device can change the energy use of devices it is connected to
- For information technology, **technology standards** serve the role the laws of physics play for other end uses
  - Can prohibit *or* require energy-saving features
  - Network is a source of both energy problems *and* solutions
- Technology standards play a role in policy for networked products unlike any other policy element

Technical approaches to reduce network-related energy

- Reduce power required for network links (and network functions)
- Power manage networked devices
  - scale internal power in proportion to task requirements or throughput (all modes)
  - change power state without cooperation of the network
  - change power state in coordination with the network
- Reduce services delivered

But first,

Product usability

- People don't buy products to save energy; they buy them to be functional
  - Energy saving should compromise functionality minimally, or not at all
  - Ideal to *improve* functionality with energy-saving features
- Latency (delay) a key issue with networks
  - People and devices
- Clarity and consistency in user interfaces and across technologies can help
  - IEEE 1621: Power Control User Interface Standard

Policy to support technical options

- Energy standards that recognize technologies
- Energy standards that require technologies
- Test procedures to enable the above

- Roadmap for needed network technology
  - Describe the future we want to have
- Policy signals for technology development
  - Tell technology industry what we want
  - Help create technologies

Network Standby in energy policy — almost 20 years old

- Energy Star has origins in network standby
  - First spec – 1992 – PCs and monitors
    - Required ability of PCs and monitors to go to sleep
    - Maximum power levels in sleep
    - Referenced a communication standard – VESA/DPMS
    - Relied on coordination between two devices
  - Second spec – 1994 – Printers
    - Maximum power levels in sleep
    - Required maintaining network connectivity in sleep
- Now, 8 specs deal with network
  - Testing, allowances, power mgmt., low-voltage DC, …

Functions

Communication – Devices
- Remote control - power
- Remote control - other signals
- Data connectivity
- Network connectivity – physical
- Network connectivity – content

Communication - People and the Environment
- Sensors
  - Temperature, Ambient Light, Audio, Motion, Atmospheric Pressure, Fluid/Gas Motion
- Displays
  - Audio, Tactile, Visual, Power Indicator
- Input
  - Audio, Visual, Touch, User Input (keys/switches/buttons)

Time
- Timer (tracking relative time)
- Clock (keeping absolute time)
- Schedule (act based on time)

Power
- EMC filters
- Surge protection
- Battery Charging
- Power Distribution

Other
- Memory
- Quick wake up
- Various safety and protection functions (ELCB, flood, child lock, movement cutout (iron))

"Periodic Table of Functions"

Communication - devices	Communication - people and environment	Time	Power	Memory	Other
Remote power	Temperature sensor	Timer	EMC filter	Volatile memory	Quick wake
Remote other	Light sensor	Clock	Surge protection	Non-vol. memory	
Data	Audio sensor	Schedule	Not Charging		
Network	Motion sensor		Charging		
	Pressure sensor		Powering		
	Fluid/gas sensor				
	Audio display			Color Code	Category
	Tactile display				Low power
	Visual display				Medium power
	Power indicator				?
	User input device				High power

The Framework

- Have standard "library" of policy content
- Policy based on functions in mode
  - Modes defined by functions, not vice-versa
- Functions are consistent across all products
- Policy defines test procedure for product based on modes with required functions
- Power requirements *may* be increased by standard power values for function
- Other requirements also drawn from library
- Policy grounded in:
  - Good network architecture, highly effective power management, and efficient low-power modes

The Framework (2)

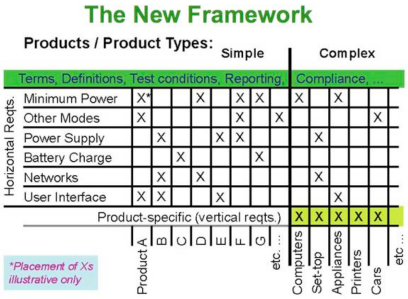
- Intended to find that point that minimizes complexity but maximizes energy savings
  - Best for industry
  - Best for policy
- Applies horizontal features as widely as possible
  - And no farther
- Assumes engagement with technology development to reduce power cost of functions, and improve power management
- Framework intended to be used globally

Technology strategy

- Work with IT industry to change content of technology standards to enhance energy efficiency
  - Revisions to existing standards
  - Assisting ongoing standards development
  - Instigating new standards projects
- Examples
  - Energy/power reporting over Internet Protocol
  - Network standards that provide low-voltage DC power (USB, Ethernet, …)
  - Audio/video inter-device power control
  - DOCSIS cable modem standard

Selective application of requirements

- Not all content (testing, regulation, …) applies to all products



Challenges / Next Steps

- Ensuring power management schemes are
  - Well-defined
  - Effective
  - Compatible with human needs and expectations
- Clarify interactions between horizontal and vertical standards
- Adapt test procedures – see EEDAL 2009
  - "Network connectivity and low-power mode energy consumption", Nordman Bruce, Hans-Paul Siderius, Lloyd Harrington, Mark Ellis, and Alan Meier
- Create 'library' of network content

Summary

- Networks drive energy use in new and important ways
- Many opportunities to reduce energy use in context of networks
- New framework
  - Widely (not universally) horizontal
  - Requires a technology / policy strategy
    - Standby policy highly relevant
  - Highly cost-effective
  - Manages inherent complexity
  - Inherently global

Thank you